UNITED STATES MARINE CORPS
Logistics Operations School
Marine Corps Combat Service Support Schools
Training Command
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LVSM 7306

STUDENT HANDOUT

MAINTAIN THE MK18 HYDRAULIC SYSTEM

LEARNING OBJECTIVES

1. Terminal Learning Objective: Given an MK48/18, required tools, test equipment, shop supplies, TM 2320-20/12, and Supplement, per information contained in the references, maintain the MK18 hydraulic system. (7.3.3)

2. Enabling Learning Objectives:

a. Given an MK48/18, required tools, shop supplies, repair parts, test equipment, TM 2320-20/12, and Supplement, per information contained in the references, diagnose a malfunctioning MK18 hydraulic system wherein the:

(1) Mast will not tilt down (remote and manual). (7.3.3a)

(2) Roller jack will not lower or raise (remote and manual). (7.3.3b)

(3) Mast under a load will not tilt up or tilts up slowly (remote and manual). (7.3.3c)

(4) Winch will not wind out (remote and manual). (7.3.3d)

(5) Crossbeam chain will not move in or out (remote and manual). (7.3.3e)

b. Given an MK48/18, required tools, shop supplies, repair parts, test equipment, TM 2320-20/12, and Supplement, per information contained in the references:

(1) Adjust the mast chains. (7.3.3f)

(2) Replace the crossbeam chains. (7.3.3g)

(3) Adjust the crossbeam chain tubes. (7.3.3h)

OUTLINE:

1. PRINCIPLES OF OPERATION OF THE MK18 HYDRAULIC SYSTEM

a. The MK18 lift system is designed to load and unload ISO/ANSI containers with a weight of up to 45,000 pounds or, with the help of the winch, the ribbon bridge and bridge erection boat and cradle.

b. Hydraulic fluid to power the MK18 hydraulic system is supplied by the MK48 which is capable of supplying hydraulic fluid at 3,250 pounds per square inch (psi) or a rate of sixteen gallons per minute (gpm). At 3,250 psi, the flow is zero and at 16 gpm, the pressure is close to zero.

(1) Before the hydraulic fluid is introduced to any hydraulic component in the MK18 hydraulic system, it first passes through the hydraulic in-line filter.

(2) After filtering, the fluid then goes to the emergency shutoff valve (SV9) and passes through it to get to the directional control valves (SV1 thru SV7), which can be operated either electrically or mechanically. When a directional control valve is actuated, it allows hydraulic fluid to flow to the applicable cylinder or winch motor and the operation occurs.

(3) After actuating the directional control valves, the fluid must pass through the pressure control valves. Those valves are located throughout the hydraulic system and limit the pressure at each cylinder to the pressure required for the cylinder to perform its function. The hydraulic pressure is kept as low as possible for operator safety and to increase the life of the cylinder.

(4) During operation of the main cylinder to extend or retract the inner mast assembly, fluid is directed at a pressure of 2,058 psi to the operating end of the main cylinder. A pilot control check valve prevents the cylinder from retracting in the event of a loss of fluid pressure.

(5) When the crossbeam cylinders are actuated to lift an ISO/ANSI container, fluid is directed to the operating end of the crossbeam cylinders at a maximum pressure of 3,250 psi.

(6) Two 6 inch bore tilt cylinders provide the lifting power required to tilt the mast from a horizontal to a vertical position and power to support the mast assembly as it is lowered from the vertical to the horizontal position. Fluid is directed to the operating ends of the tilt

cylinders at a maximum pressure of 3,250 psi by a tilt cylinder directional control solenoid valve.

(7) When the vehicle is placed in the container mode and on a hard surface such as a pier or parking lot while loading a full container, the roller jack assembly should be lowered for additional support to the MK18. Fluid is directed to the operating end of the roller jack cylinder at a maximum pressure of 3,250 psi.

b. If a ribbon bridge or bridge erection boat and cradle are being loaded, the MK18 must be in the bridge/boat mode. This is the only time the hydraulic winch is used. To configure the MK18 for the different modes, the operator must follow the steps in TM 2320-10/11 Supplement 1.

(1) The vehicle is equipped with a winch which is hydraulically operated, has a capacity of 10,000 pounds and is controlled electrically through the remote control unit (RCU) or by the manual control levers.

(2) The winch motor operates on hydraulic fluid supplied by the MK48 which provides more than enough pressure and volume to operate the winch.

(3) A safety feature of the winch is the winch brake. During operation, the winch brake must receive a hydraulic fluid pressure of 225 psi before it will release the cable spool to pay out the cable. In the event that hydraulic pressure is lost, the brake will lock and prevent the load from dropping. The brake will remain on until hydraulic pressure is restored to above 225 psi.

2. IDENTIFICATION, LOCATION, AND FUNCTION OF THE COMPONENTS EMPLOYED IN THE MK18 HYDRAULIC SYSTEM

a. Hydraulic In-Line Filter. As with the MK15 and MK17, hydraulic power to the MK18 is supplied by the MK48. The fluid first passes through an in-line, ten-micron filter located behind the junction box. The cartridge is initially changed after fifty hours of operation and then semiannually or whenever contamination is suspected in the hydraulic system.

b. Emergency Shutoff Valve (SV9). The emergency shutoff valve (SV9) is an electrically controlled spool valve that is mounted behind the MK18's tool box. When current flow to this valve is stopped, the valve disables the MK18 hydraulic system by directing all the hydraulic fluid delivered by the MK48 back to the MK48 via the return line, before the fluid can reach any other component.

c. Winch Assembly. The winch assembly is located on the underside of the lift mast and consists of a winch motor, gear box assembly, spool assembly and brake assembly.

(1) The winch motor converts hydraulic power supplied by the MK48 to mechanical power to turn the gear box. The speed of the motor is determined by the flow rate of the fluid and the torque developed by the motor is determined by the fluid pressure.

(2) The winch motor drives the gear box which has a spool attached to it. The gear box is housed in the sealed spool and runs in an oil bath inside the spool.

(3) The spool stores the cable, unwinds the cable when WINCH OUT is selected and winds the cable when WINCH IN is selected.

(4) The winch brake assembly is mounted between the winch motor and the gear box/spool assembly by splined shafts. The brake is a spring-loaded stator/rotor and applies braking power whenever hydraulic pressure to the winch falls below 225 psi. With the brake applied the winch will not turn.

d. Winch Pressure Control Valve. The winch pressure control valve is mounted on the left mounting bracket of the winch and has three functions.

(1) First, it limits the speed of the winch motor during unloading operations to compensate for the weight of the ribbon bridge or boat and cradle. Speed limiting is accomplished by limiting the hydraulic pressure on both sides of the hydraulic winch motor. The preset pressure is 3,625 psi. This setting is the sum of the input and output pressures of the winch motor. During loading operations, the pressure control valve allows free flow without pressure limitations to the motor.

(2) The second function of the winch pressure control valve is to release the brake during winch operations whenever fluid pressure to the winch exceeds 225 psi.

(3) The third function is to stop the motor immediately if hydraulic pressure to the winch is lost. This is accomplished in two ways:

(a) first, the valve will not open and allow the motor to function; and

(b) second, the brake will activate.

e. Winch Cable Tension Solenoid Valve (SV8). The winch cable tension solenoid valve is located beside SV10 (tilt over center solenoid valve) on the second cross member from the front of the MK18. It is a two-position solenoid valve used to stop the flow of fluid to the winch motor if the cable becomes slack during winch out operations, thus preventing the cable from becoming entangled on the winch spool.

f. Functional Control Valve Manifold (SV1-SV7). Each major hydraulic assembly is controlled by a function valve which may be electrically or mechanically operated. When a functional control valve is actuated, it allows hydraulic fluid to flow to the applicable assembly and allows that assembly to function. There are seven functional control valves, each with an A and a B side, attached together to form a manifold. The functional control valve manifold is normally used in the event of a remote control unit malfunction or for configuration purposes.

g. Bridge Lock Cylinder. The bridge lock cylinder is stowed on the right side of the main mast frame. It is a three inch bore cylinder that is used only in the bridge/boat mode. Part of the bridge lock assembly must be manually positioned when it is required for use. Two hydraulic lines are connected to the cylinder by quick-disconnect fittings on one end, and two quick-disconnect fittings on the left lift (tilt cylinder) mast assembly on the other end. When not in use, the two hydraulic lines are stowed in the tool box.

h. Tilt Cylinders. There are two tilt cylinders, one on each side of the lift mast. They are six-inch bore cylinders that raise and lower the lift mast assembly. Fluid is directed to the operating end of each cylinder at a maximum pressure of 3,250 psi. The tilt cylinders can be operated with the RCU in either the container or bridge/boat mode.

i. Tilt Cylinder Pressure Control (Burst) Valves. There are two tilt cylinder pressure control valves, one on the piston end of each tilt cylinder. The valves, which are also called burst valves, have two functions.

(1) First, they limit the speed at which the tilt cylinders can lower to compensate for the weight of the unit being loaded. Speed limiting is accomplished through the valve by maintaining a minimum pressure of approximately 1,100 psi on the return side of the cylinder.

(2) The second function is to stop the cylinder from extending or retracting if pressure is lost. The pressure control valve operating pressure is set at the factory and should never be changed.

j. Tilt Cylinder Over Center Solenoid Valve (SV10). The tilt cylinder over center solenoid valve (SV10) is located beside SV8 on the second cross member on the front of the MK18. When loading or unloading ISO/ANSI containers, SV10 limits mast movement past 90 degrees if the operator is using either the RCU or the manual controls. This valve is not functional in the bridge/boat mode; therefore, the mast will tilt past 90 degrees for bridge and boat cradle operations.

k. Main Cylinder. The main cylinder is located in the center of the inner mast. It is a six-inch bore cylinder that extends and retracts the inner mast assembly. The cylinder end is connected to the inner mast and the barrel end is connected to the frame of the lift mast. Fluid is directed to the operating end of the cylinder at approximately 2,050 psi.

l. Main Cylinder Pressure Control Valve. This valve is mounted on the main cylinder and has two functions.

(1) First, the valve limits the speed at which the cylinder retracts during unloading operations to compensate for the weight of an ISO/ANSI container. Speed limiting is accomplished by maintaining a minimum pressure of approximately 870 psi on the return side of the cylinder.

(2) The second function of the valve is to stop the main cylinder (lock it in place) if hydraulic pressure is lost during retraction. When using the RCU, the main cylinder will only function in the container mode.

m. Main Cylinder Pilot Control Check Valve. It is mounted on the crossmember with the winch (SV8) and tilt over center solenoid valves (SV10). The pilot control check valve ensures that the main cylinder does not retract when fluid pressure is lost. If pressure is lost, the check valve closes and blocks the return of fluid from the cylinder. With the return blocked, the cylinder cannot retract, rendering the cylinder inoperable.

n. Crossbeam Cylinders. The two crossbeam cylinders are three inch bore cylinders and are located in the sliding carriage assembly. The left cylinder provides lifting power for the right crossbeam chain and the right cylinder provides lifting power for the left crossbeam chain.

o. Crossbeam Cylinder Pressure Control Valves. Each crossbeam cylinder has a dedicated pressure control valve mounted on it. The valves have two functions:

(1) First, the valves limit the speed at which the cylinder can extend during unloading of an ISO/ANSI container to compensate for the weight of the container. Speed limiting is accomplished by maintaining a minimum pressure on the return side of the cylinders.

(2) Second, the valves prevent the cylinders from extending if hydraulic pressure is lost because of a hydraulic supply line break or a hydraulic power loss.

p. Roller Jack Cylinder. This three inch bore cylinder provides the power required to raise or lower the roller jack assembly located at the rear of the MK18. The roller jack assembly provides additional rear support during ISO/ANSI container loading and unloading operations.

q. Roller Jack Dual Check Valve. The roller jack dual check valve is located on the left side of the main frame above the roller jack assembly. The purpose of the roller jack dual check valve is to ensure that the roller jack is locked in place when no fluid is flowing to or from the roller jack cylinder. When no fluid is flowing, the dual check valve closes both hydraulic lines and locks the cylinder in position. When hydraulic fluid is directed to the cylinder, the valve opens and fluid is free to flow.

3. ORGANIZATIONAL MAINTENANCE RESPONSIBILITIES FOR THE MK18 HYDRAULIC SYSTEM

a. Organizational maintenance personnel have the responsibility of troubleshooting malfunctions of and inspecting all of the hydraulic components and replacing most of them. However, repair of the individual components is mainly the responsibility of a third echelon maintenance organization, such as Motor Transport Maintenance Co.

b. Lubrication of the MK18 is primarily the responsibility of the operators or crew. However, replacement of the pressure line filter and the winch gear box oil is the responsibility of the organizational maintenance mechanic.

c. Although repair of all these components cannot be taught during this class due to time constraints, the procedural steps for troubleshooting, inspecting and replacing each of the components are covered in the technical manuals that pertain to this vehicle and accomplishment of the procedure should present no special problems for you.

4. REPAIR A FAULTY MK18 HYDRAULIC SYSTEM

a. Detailed instructions for diagnosing a malfunction and repair of the MK18 hydraulic system are contained in TM 2320-20/12A and Supplement 1. Carefully read and follow those instructions to effect the diagnostic procedures required to diagnose and repair a malfunction on the hydraulic system on the training aid vehicle to which you have been assigned.

b. We cannot dial a fault into or "bug" the hydraulic system as we did the electrical system. Therefore, when you reach a predetermined step in the

diagnostic procedures, the instructor will inform you that you have a reading that is not within specification (too high, too low, etc). From that point on, you will proceed accordingly, as if that condition does exist. When you have determined that a component requires replacement, you will notify the instructor and point out that component to him. He will advise you if you have correctly diagnosed the malfunction and determined the repairs required to correct the malfunction and master that particular task.

c. Record all pressure, voltage, and measurement readings in the spaces provided in your student handout.

d. Have the instructor assigned to your team check your work and initial at each point designated in this student handout.

e. Diagnose the Malfunction "Mast Will Not Tilt Down (Remote and Manual)"

(1) Check the lines and fittings for leaks and damage.

(2) Install a pressure gage between the tilt down line and directional control valve manifold.

(3) Manually operate the TILT DOWN lever on the directional control valve.

(4) Check for a minimum pressure of 900 psi. Record the reading.

(5) Install pressure gages at two test points on the right tilt cylinder.

(6) Manually operate the TILT DOWN lever on the directional control valve. Record the readings. FORWARD _____ REAR

STOP! Have instructor initial.

f. Diagnose the Malfunction "Mast Under Load Will Not Tilt Up or Tilts Up Slowly (Remote and Manual)"

(1) Check the lines and fittings for leaks and damage.

(2) Manually operate the over center limit switch to ensure switch SV10 is not stuck. Attempt to manually operate the TILT UP lever on the directional control valve to see if the problem still exists.

STOP! Have instructor initial.

(3) Configure the MK18 for the bridge mode.

(4) Install pressure gages at the test ports on the right tilt cylinder.

(5) Manually operate the TILT UP lever on the directional control valve until the right cylinder reaches the end of its travel. Continue to operate until the pressure reaches its maximum. Check for a minimum pressure of 3,200 psi on the front gage and a maximum of 100 psi on the rear gage. Record the readings. FORWARD _____ REAR

(6) Repeat the test for the left cylinder. Record the readings. FORWARD _____ REAR

(7) Install a pressure gage between the RIGHT TILT UP line and solenoid valve SV10.

(8) Manually operate the TILT UP lever on the directional control valve and check the pressure. Record the reading.

(9) Repeat the test for the left tilt cylinder. Record the reading.

STOP! Have instructor initial.

g. Diagnose the Malfunction "Right Chain Will Not Move In or Out (Remote and Manual)"

(1) Check the lines and fittings for leaks and damage.

(2) Check the chain for alignment.

(3) Install pressure gages between the directional control valve manifold and the hand lines for the right chain crossbeam cylinder.

(4) Manually operate the RIGHT CHAIN OUT lever on the directional control valve and check the pressure. Record the readings.

OUT _____ IN _____

(5) Install pressure gages between the flexible lines and the right chain crossbeam cylinder.

(6) Manually operate the RIGHT CHAIN OUT lever on the directional control valve and check the pressure. Record the readings.

OUT _____ IN _____

(7) Install a pressure gage at the test point on the right chain crossbeam cylinder.

(8) Manually operate the RIGHT CHAIN OUT lever on the directional control valve and check the pressure. Record the reading.

STOP! Have instructor initial.

h. Diagnose the Malfunction "Roller Jack Will Not Lower or Raise (Remote and Manual"

(1) Check lines and fittings for leaks and damage.

(2) Install a pressure gage in each of the hard hydraulic lines between the roller jack cylinder and the directional control valve manifold.

(3) Manually operate the ROLLER JACK DOWN lever on the directional control valve.

(4) Check for a minimum pressure of 600 psi in the DOWN line and a maximum pressure of 50 psi in the UP line. Record the readings.
DOWN _____ UP

(5) Repeat the test except operate the ROLLER JACK up lever on the directional control valve.

(6) Install a pressure gage between the DOWN port of the double-piloted check valve and the directional control manifold.

(7) Manually operate the ROLLER JACK DOWN lever on the directional control valve.

(8) Check for a minimum pressure of 600 psi at both ports. Record the readings. DOWN _____ UP

(9) Install a gage between the UP port of the double-piloted check valve and the directional control manifold.

(10) Manually operate the ROLLER JACK UP lever on the directional control manifold. Record the reading. _____

(11) Install a gage in each of the hydraulic lines between the roller jack cylinder and the double-piloted check valve. Operate the ROLLER JACK UP lever on the directional control manifold and record the readings.
DOWN _____ UP _____

STOP! Have instructor initial.

i. Diagnose the Malfunction "Winch Will Not Wind Out (Remote and Manual)"

(1) Check the lines and fittings for leaks and damage.

(2) Install a pressure gage at the test point on hydraulic line A5.

(3) Hold the winch cable taut, manually operate the WIND OUT lever on the directional valve and check the pressure. Record the reading.

(4) Install a pressure gage on output port C3 on the winch pressure control valve.

(5) Hold the winch cable taut, manually operate the WIND OUT lever on the directional control valve and check the pressure. Record the reading.

STOP! Have instructor initial.

j. Adjust the Mast Chains

(1) Adjust the inner mast chains.

(a) Fully extend the crossbeam.

(b) Measure the distance between the face of the crossbeam and the center of the rear twist lock. Record the reading.

STOP! Have instructor initial.

(c) Check slack in rear mast chains. Record the reading.

(d) Take up slack in rear mast chains if necessary.

(2) Adjust the rear mast chains.

(a) Fully extend the crossbeam.

(b) Measure the distance between the face of the crossbeam and the center of the rear twist lock. Record the reading.

STOP! Have instructor initial.

k. Replace the Crossbeam Cylinder

(1) Remove the right crossbeam chain.

(2) Install the right crossbeam chain.

STOP! Have instructor initial.

l. Adjust the Crossbeam Chain Tube.

STOP! Have instructor initial.

REFERENCES:

TM 2320-10/11 and Supplement
TM 2320-20/12 and Supplement